

Video Game Play and Design: Procedural Directions



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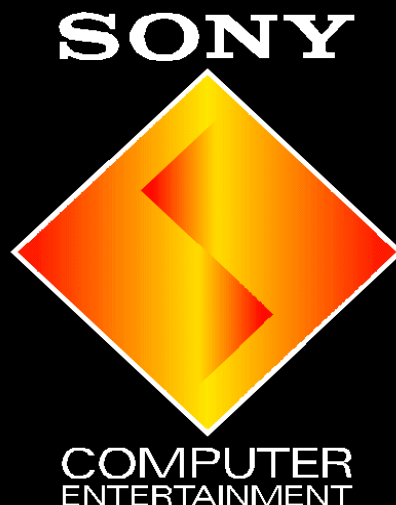


Video Game Play and Design: Procedural Directions



Procedural Techniques for Interactive CG

Dominic Mallinson

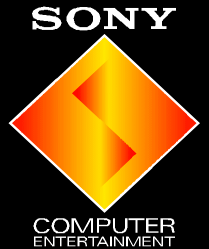


What do I mean by a “procedural technique?”

- Any description that is not explicit
 - triangle meshes are explicit
 - motion capture animation is explicit
- Procedural techniques
 - modify a description via an algorithm
 - change with the state of the simulation
 - are calculated on the fly

Dominic Mallinson

PROS of Procedural Techniques



- Interactivity
- Scalability
- Variety
- Cost
- Storage and bandwidth



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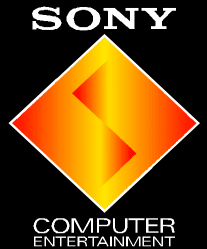


CONS of Procedural Techniques

- Not suited to everything
- Not as good as Art and Capture
 - (in a fixed situation)
- Can use lots of processor power
- Can be complex and unpredictable



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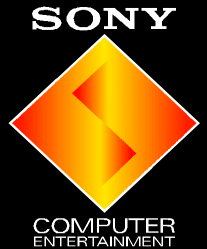


Modeling with Procedural Techniques

- Generally Good For
 - Plants
 - Terrain
 - Biological forms
- Generally Bad For
 - man made objects
 - precise representation



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Animation with Procedural Techniques

- The goal is interaction
- Simulating the Physical World
 - dynamics, cloth, fluids, smoke, fire, fracture
- Modified Animation
 - I.K. , motion blending etc.
- Behavior and Autonomous Characters
- Controllers



Modified Animation

- Using key frame artist generated or motion capture data as basis
 - interactivity requires procedural modification of the animation
 - motion blending
 - inverse kinematics
 - physical modeling

Physical Simulation

- Makes interaction look real
- Computationally very intensive
- Difficult to make robust
- Can be inconsistent in performance
- Lots of research still to be done!

Autonomous Characters

- The goal is life like character behavior
- Simple scripting and FSM
- Cognitive modeling
- Steering behaviors and path finding
- Learning algorithms
 - neural nets, genetic algorithms
 - off line vs. real time learning

Controllers

- Where behavior meets physics
 - How an ‘action’ becomes a ‘motion’
 - “Walk Forward” through an arbitrary environment
 - Avoid obstacles, balance
 - Look natural

Examples

- Lifeforms :- Latham and Todd
 - an example of procedural modeling
- Bird-Fish-Mouse
 - autonomous characters
 - modified animation
 - procedural water

Video Game Play and Design: Procedural Direction



Procedural Simulation: Time To Get Real

Tom Hachert



SONY PICTURES
IMAGWORKS



SIGGRAPH
2001

Procedural Simulation

- Realistic Behaviors - “A.I.”
- Any “On-The-Fly” Generated Action/Asset
 - NPC’s, Terrain, Textures, Weather, etc.
- Advantages:
 - Sophistication, Volume, Speed, Reusability
- Drawbacks:
 - Emerging Science, Complex, Expensive

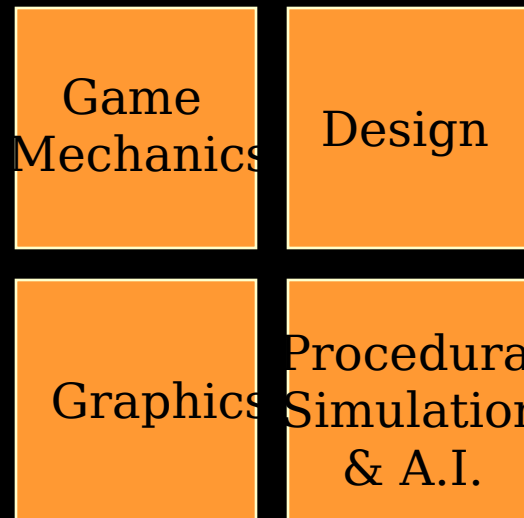
Overview

- Evolution of Game Consoles
 - More cycles, more storage, dynamic content
 - Procedural simulation as emerging R&D
- Impact on 3 Fronts:
 - Users
 - Developers
 - Unlikely Partners

The Old Days: Cram It In...

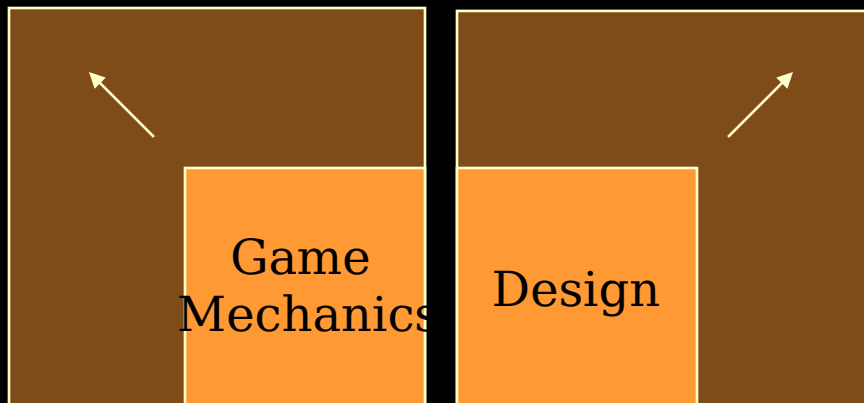
- Graphics, Mechanics, Design
 - Balancing cycles, storage
- Procedural Simulation
 - Pushes boundaries of game technology
 - Often forced to utilize “leftover” resources

Fitting It All In The Box



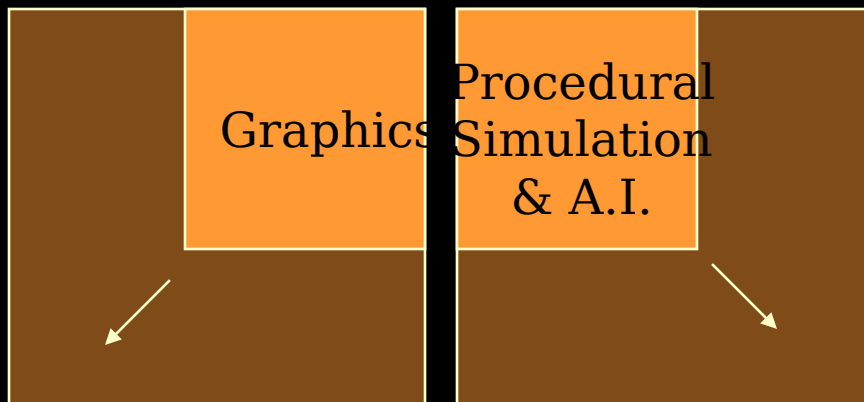
A Bigger Box To Fill...

- Advanced UI,
- Physics Engines,
- Smart Cameras, etc.



- Massive Worlds,
- Hybrid Genres,
- Sophisticated Sound, Stories, etc.

- Higher-Res Models,
- Natural Movement,
- Photorealism, etc.



- Smarter NPC's,
- Responsive Environments,
- ???

Today: Still Cramming, But...

- Faster Hardware
- High Capacity Delivery
 - CD v. DVD
- Local Storage
- Additional Content Via Internet

All Lines Point To Procedural Simulation

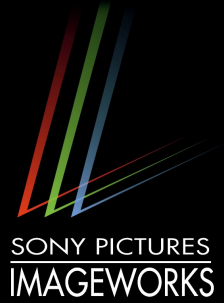
The X Axis: The User

- Deeper, Richer Content
 - Experience to showcase hardware capability
- Enhanced Gameplay
 - Smarter NPC's,
 - Wider variety of interactions
 - Variations from session to session
- Immersive Style Over Hyperrealism

The Y Axis: The Developer

- “That’s A Damned Big Box...”
 - Producing enough content
 - Internet connectivity = even more content
 - More money + more time = greater risk
 - Mechanics, Design, Graphics & A.I. all demand higher levels of expertise
 - How can I supplement my talent pool & spread my risk?

The Z Axis: Unlikely Partners



- The Motion Picture/TV Effects Industry
 - Historically overlapping talent pool
 - Gap in CG and Procedural Simulation narrowing
- Academia
- Console Manufacturers
- Other Centers of CG Research
 - Architecture, Medicine, Engineering, Military



Procedural Simulation

Satisfying:

- The User
 - Provides deep and challenging content
- The Developer
 - Provides economic way to produce larger volume of rich, innovative content
- The Now-More-Likely Partners
 - Additional revenue source
 - Real World application of their code

Making Procedural Simulation Work



- Development of Modular Code
 - Approach like a Graphics Engine
 - Amortize over multiple titles
- Enlist 3rd Party Resources - Joint Ventures
- Strive For Balanced Gameplay
- Establish Defining Style Instead of Realism



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AI for Virtual Humans

Project



A bit of background...

- *Major goal at ICT:*
Create compelling VR environments for training
 - High quality graphics
 - Immersive sound
 - Strong storyline
 - Virtual humans

AI Virtual Humans

- Behaviors not pre-scripted
 - Behave by understanding situation and reasoning about possibilities
- Communicate in natural language
- Can explain actions & coach
- Respond emotionally to situation

Looking back....

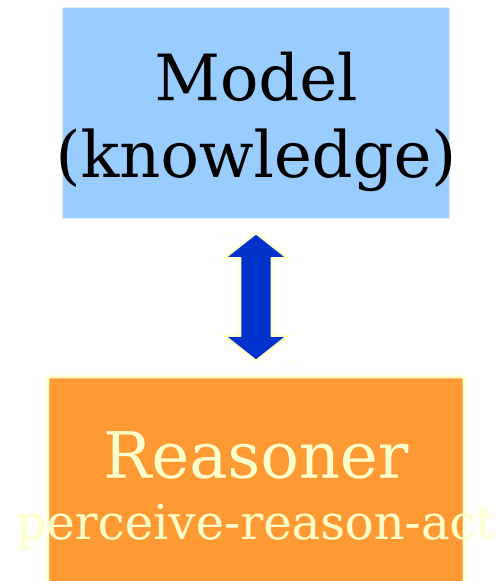
- Early attempts failed to create unified intelligent systems exhibiting a broad variety of behaviors

What's different now?

- Faster, more powerful (& cheaper) hardware
- Some of the hard problems have working solutions
 - e.g. speech recognition
- Better software environments support modular architectures
 - Don't have to build it all yourself
- Hybrid approach: synergy through mixing techniques
 - Symbolic, probabilistic, neural nets, etc

What's different now? (cont')

- Model based programming



Example: Model Based Programming for Task Oriented Domain

Model

Task1

Preconditions:

Effects:

Task2

Preconditions:

Effects:

Task3

Preconditions:

Effects:

Task4

Preconditions:

Effects:

Reasoner

Task3 → Task4 → Task1

- Robust to changes in world state
- Model easier to modify
- Model explainable
- Model can be used to understand other's actions

Mission Rehearsal Project: Operations in the New Millennium



Mission Rehearsal Exercise Project

- Virtual Reality Environment
 - Immersive Audio and Graphics
 - Virtual Humans with reasoning and emotion
 - Locals
 - Friendly and hostile elements
 - Coach
 - Dilemmas and decisions

Bill Swartout

ICT Virtual Reality Theater



Mission Rehearsal Clip

Coaching

Missing Emotions



Adding Emotions



Summary

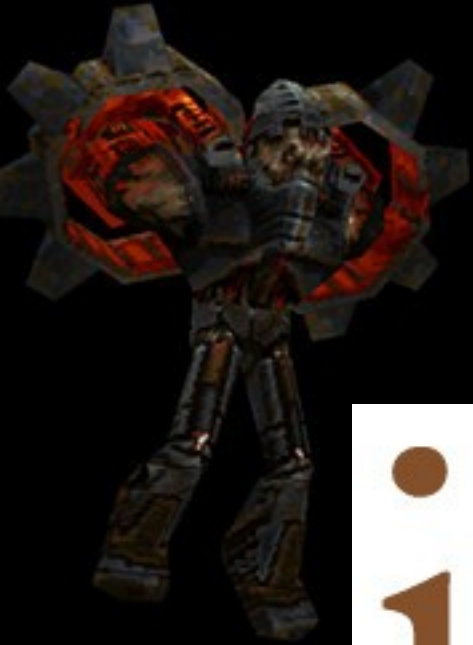
- Using AI we're beginning to create characters that have much richer behaviors and depth
- Opens up possibility for new kinds of games

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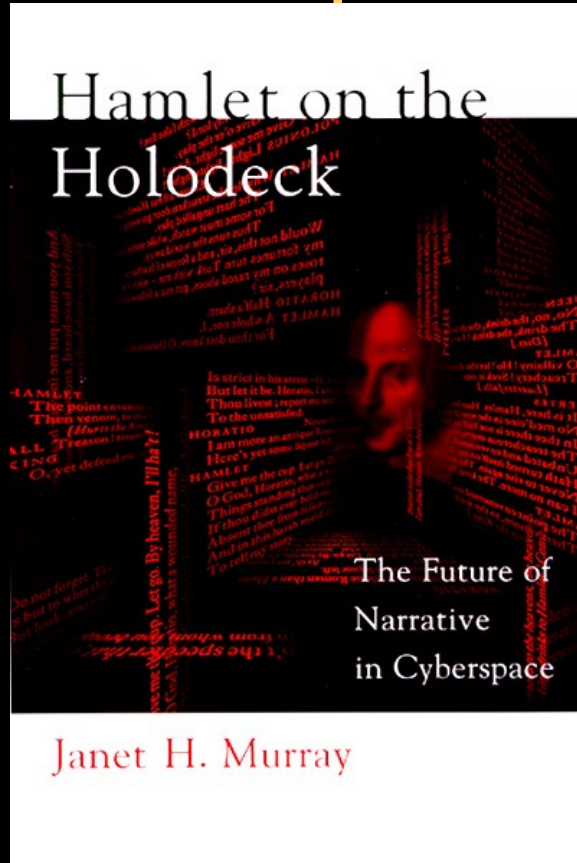


Procedural Character Design

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Computer as Storytelling



Medium

Can there be significant new forms of storytelling in the new digital medium?

- Yes, because it has its own expressive properties

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What would it take to get there?



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Characters Past



Tell me more about your mother.

Eliza's animation did NOT

- Still images in
- Moving images **Tell me more about your mother**
- Sound
- “Multi” media Joseph Weizenbaum,
Eliza 1966

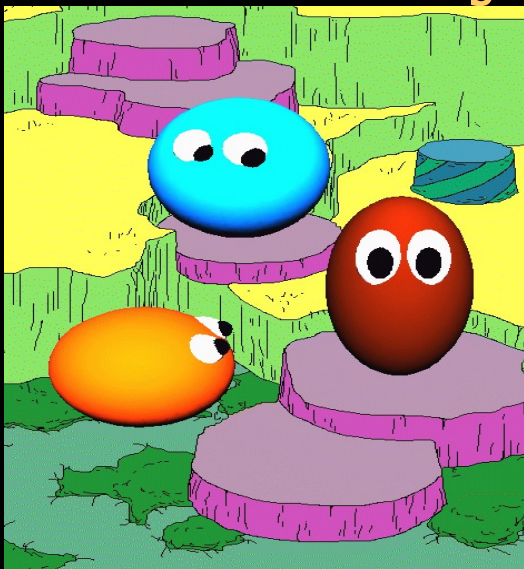
Why Eliza Works

Tell me more about your mother.

Joseph Weizenbaum, Eliza 1966

- Pattern matching
- Shtick=formula
- Scripting the interactor
- Scenario!!

Why Woggles Worked



**Joseph Bates,
Woggles 1992**

- Readable cartoon gestures of greeting, inviting, fear, menace...
- Shrimp's programming glitch provided needed dramatic focus
- Believability not realism

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Virtual Pets

Silas, Bruce Blumberg, MIT
1994



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Petz

Dogz, PFMagic 1990s





Autonomous Agent Architectures

Silas

- Based on science of animal behavior
- Elaborated model of inner states
- Everyday props, e.g. ball
- More complex, less dramatic

- Based on shtick of cartoon critters
- Expressible model of inner states
- Dramatic props, e.g. mouse, catnip
- Less complex, more fun



Lessons from the Past



- Scenario shapes expectation
- Props shape participation
- Don't program what you cannot display
- Believability not realism
- Character elicited by interaction



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Characters Present



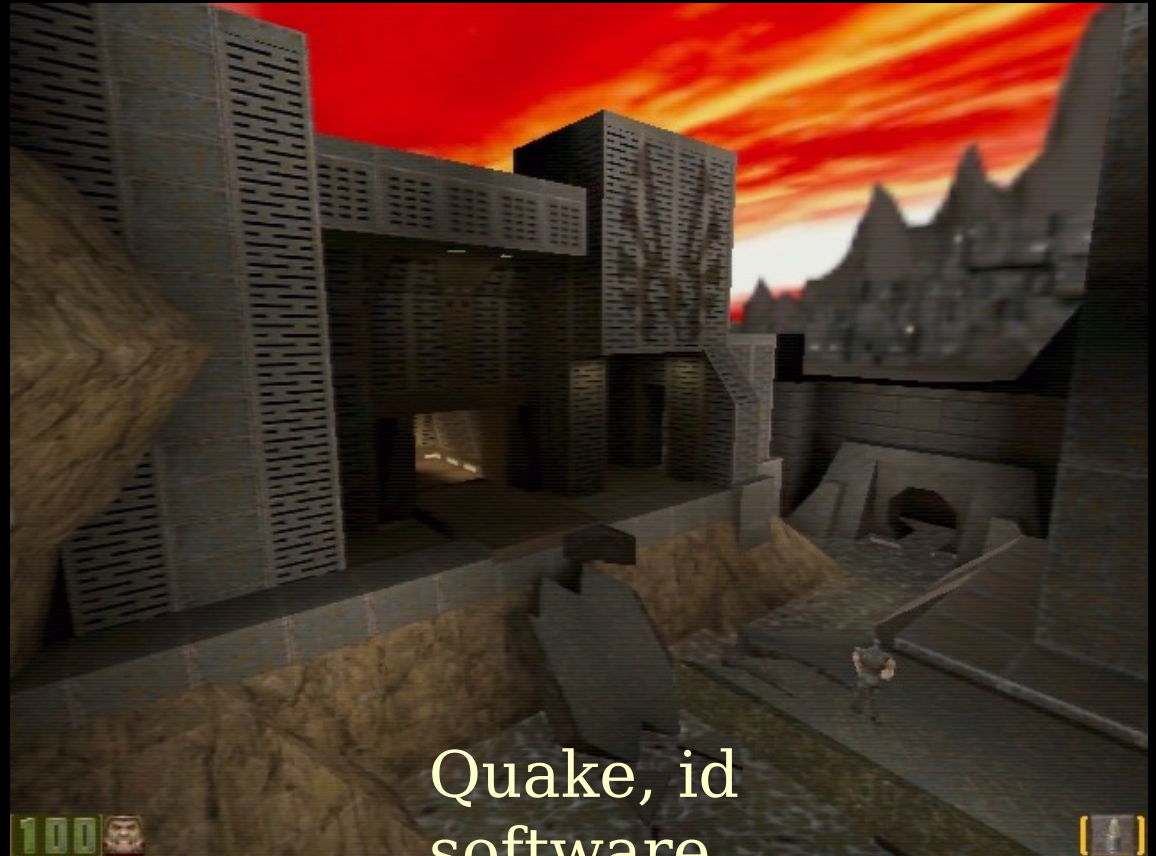
Characters in Immersive Worlds

- Genre fiction world provides scenarios, props, potential dramatic actions
- Detailing reinforces believability
- Range of characters limited



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Weapon/Target Characters



Quake, id
software

Targets or Characters?

- Do they have their own trajectories?
- Do they move and act when we can't see them?
- Are they most interesting when on fire?



Deus Ex

Buddy Character



Paul Deus Ex

Hero and brother/sidekick are extensions of their weaponry

MMORGs: Massively Multiplayer Online Roleplaying Game

- Expressive gestures derived from genre scenarios
- Need for dramatic compression
- More backstory than can be expressed in gameplay

Will Wright's The Sims (2000)

Yuppy scenario: shop, work, party,
marry, parent
Persistent, detailed, participatory world

Why the Sims Works

- Readable social actions
- Bildungsroman plot, courtship and work ethic scenarios
- Expressible states
- BUT: problem of focus remains



Improving Character Simulations



Compression

- Time
- Event structure
- Episodic structure

Dramatic Actions

- Fewer Chores!
- Dramatic Props

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Characters Future



Parameterized Characters

Questing hero:

- Heritage Group
- Appearance
- Clothing
- Profession
- Attributes
- Skills

Parameterized Characters



Roommate:

- Neat
- Outgoing
- Active
- Playful
- Nice

Parameterized Characters



Danish Prince??

- melancholy?
- tolerance for flattery?
- irony?
- self-doubt?
- homicidal/suicidal?
- madness meter?!

Cyberdrama



the holodeck hamlet?

Dramatic

Characters

?

?

Replay Story

Scenario

Stereotype

Behavior



Genre Types



Robot Yuppies



Superkiller's helper



Comical Pets



Shooter's Targets



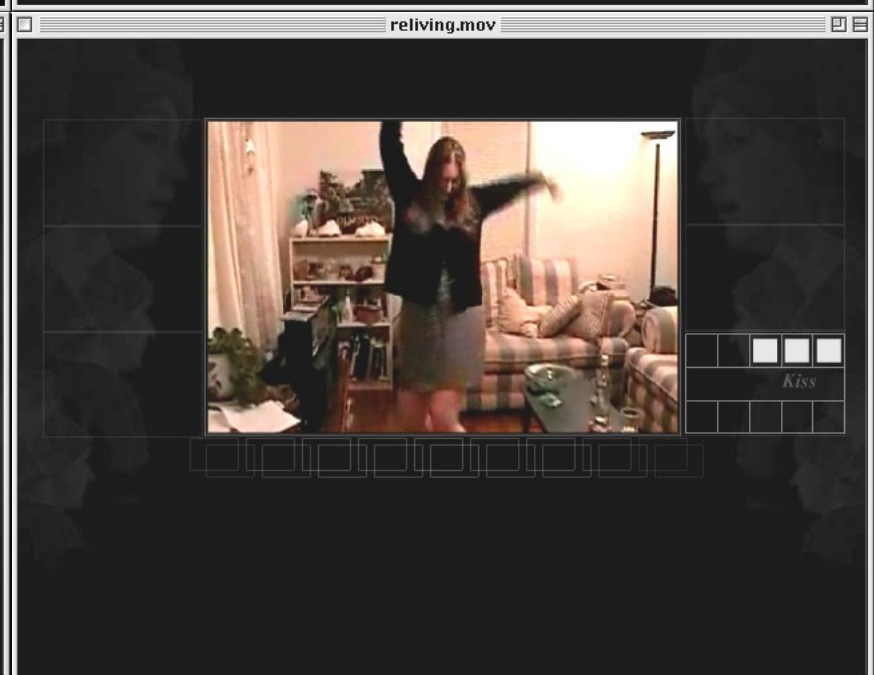
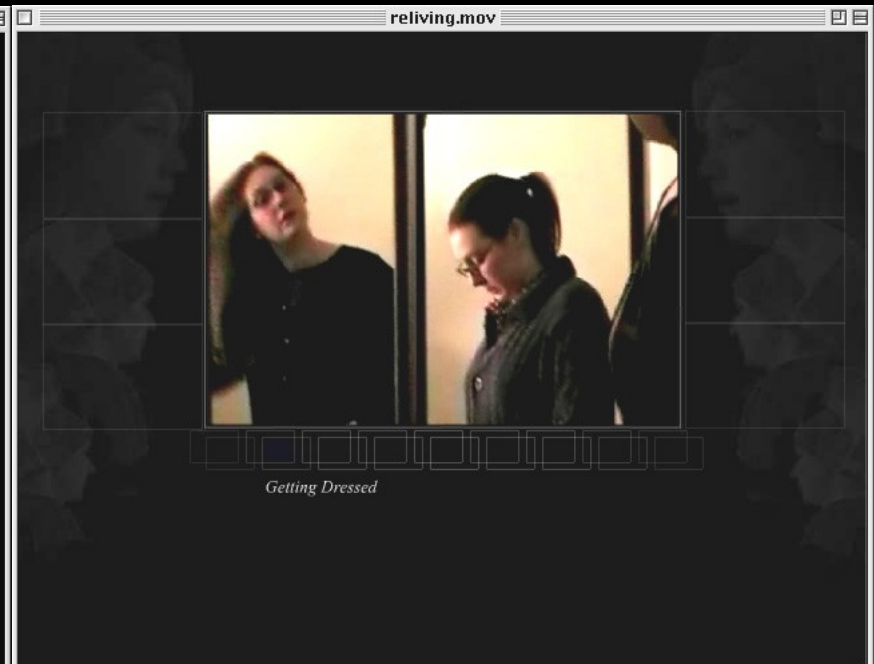
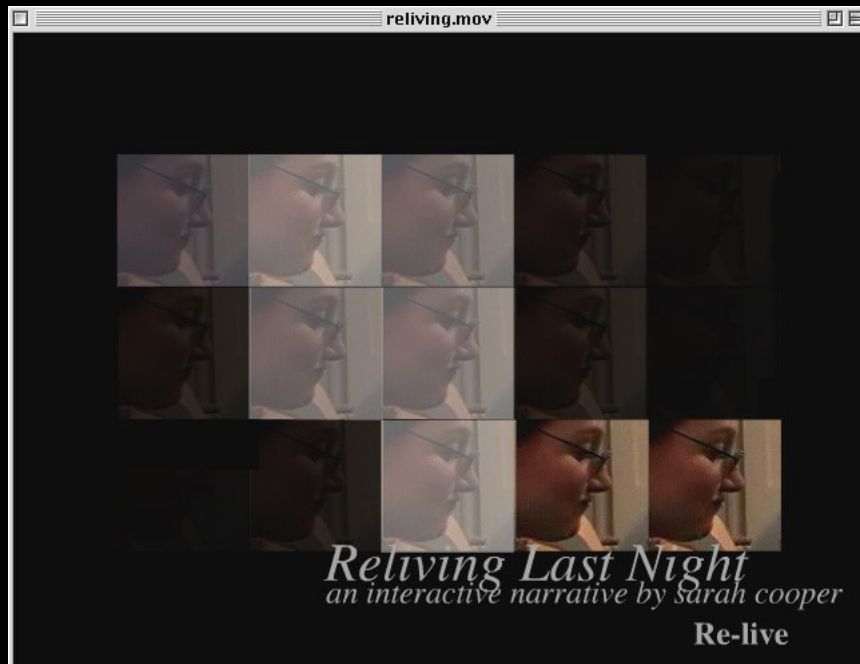
Artificial Life

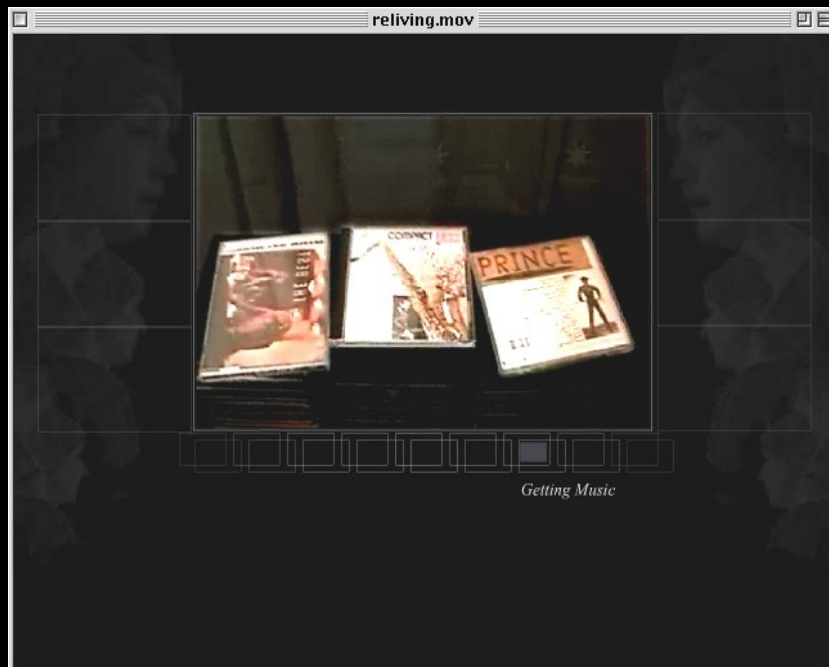
Game Piece

Lifelike

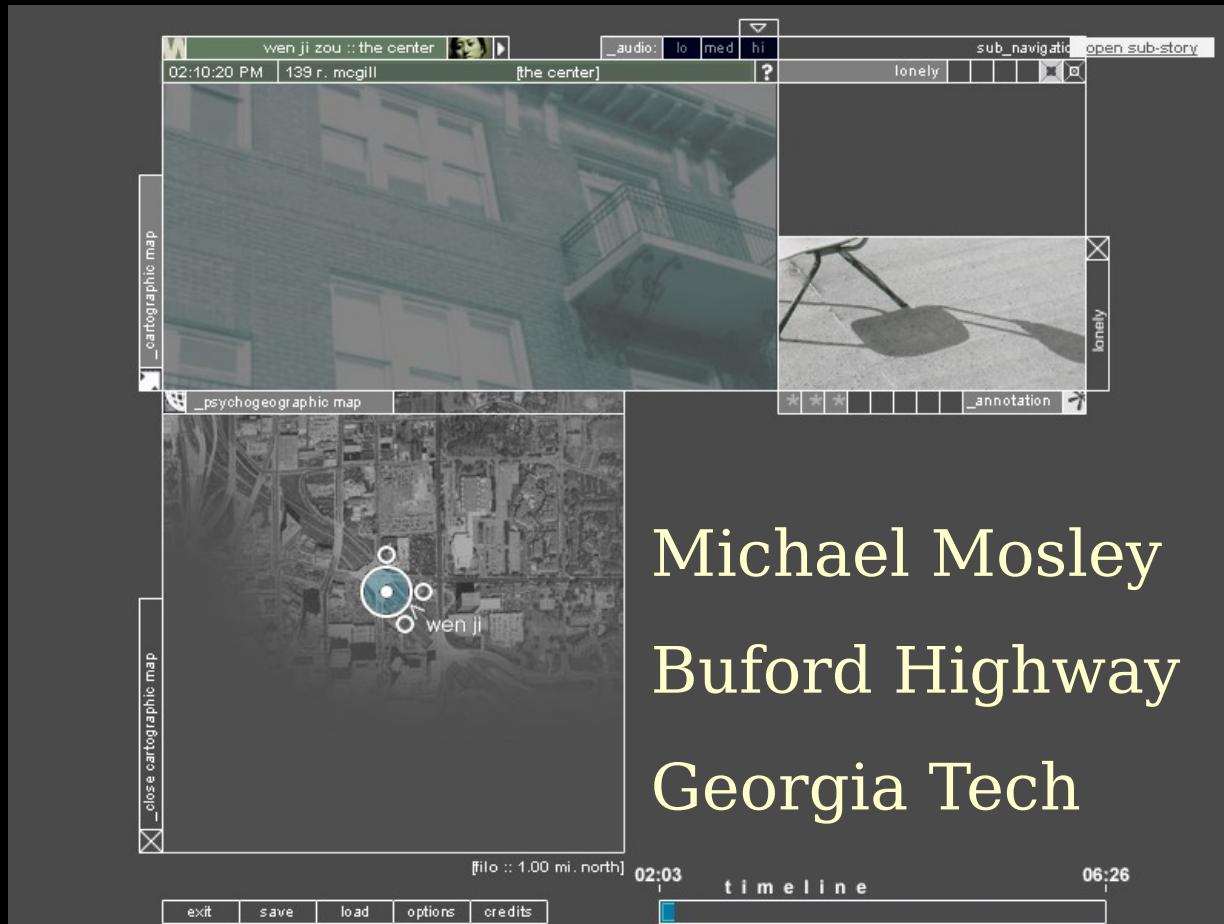
Sarah Cooper: Reliving Last Night







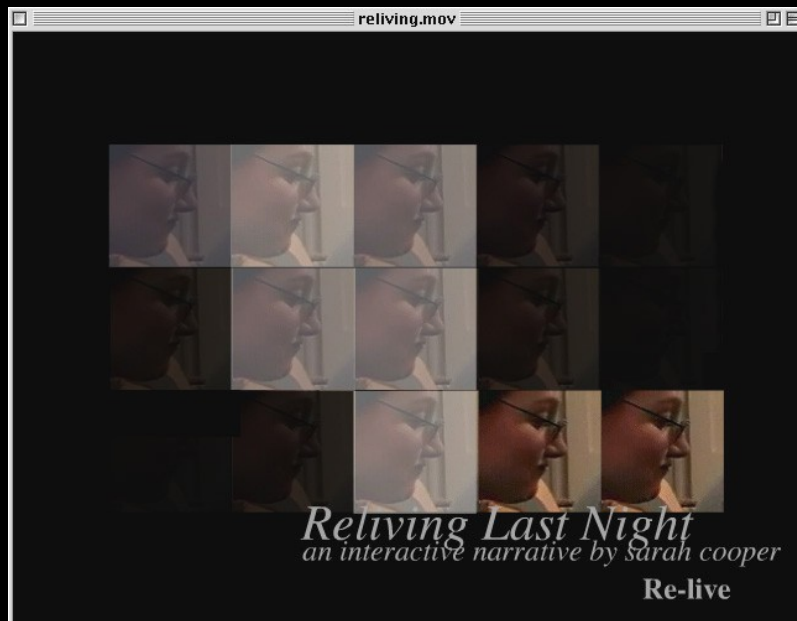
Variant character / Variant POV



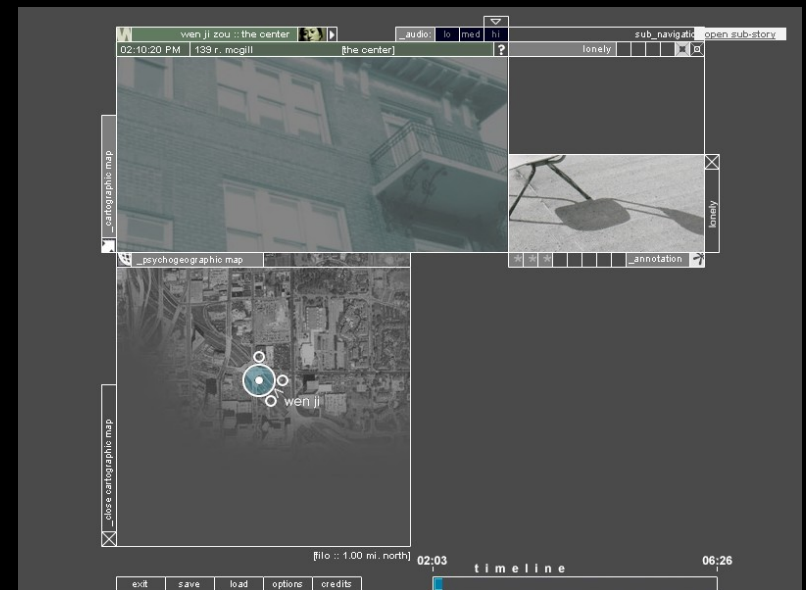
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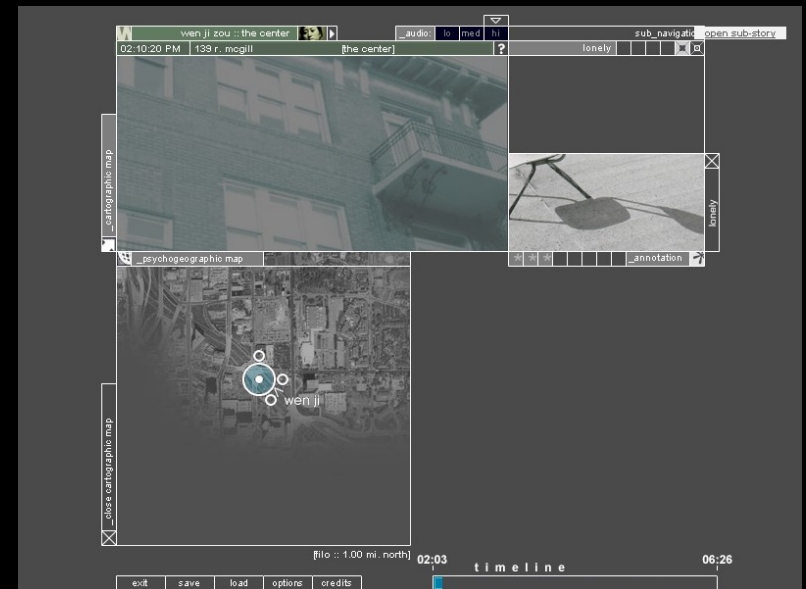
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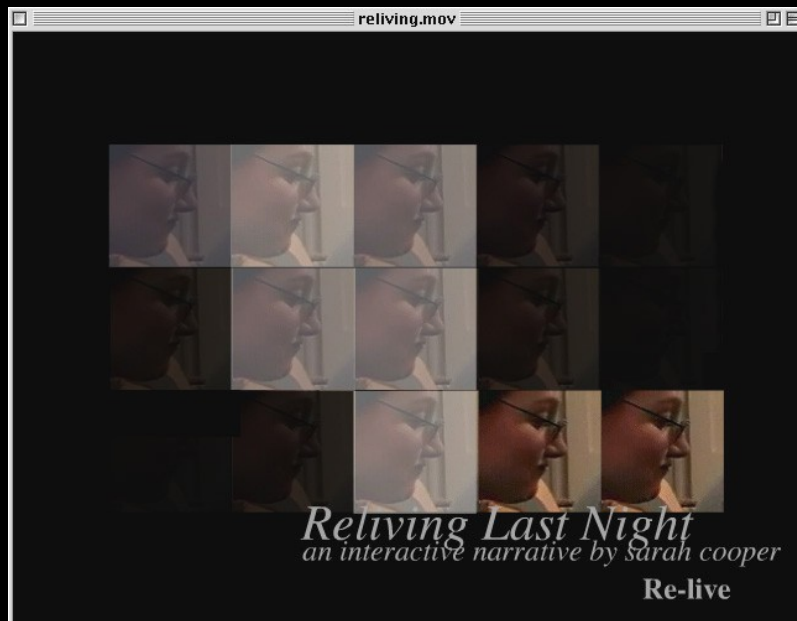
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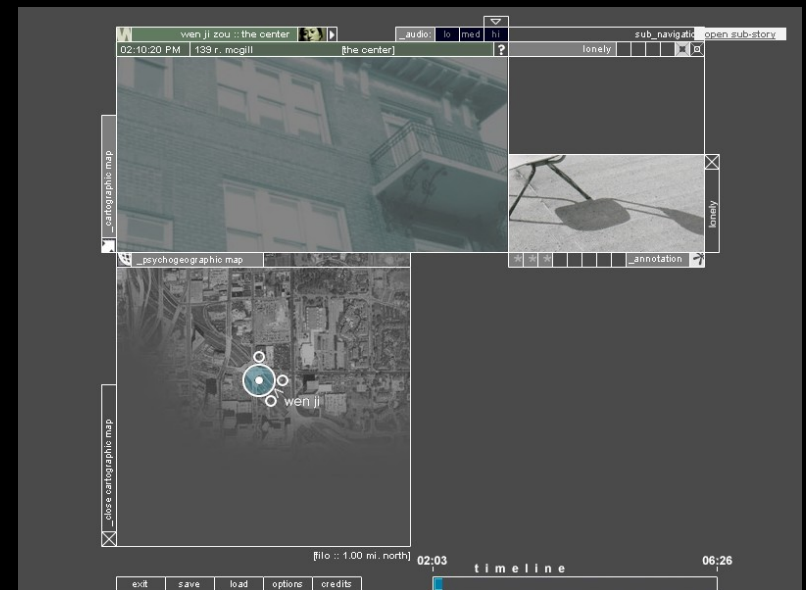
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